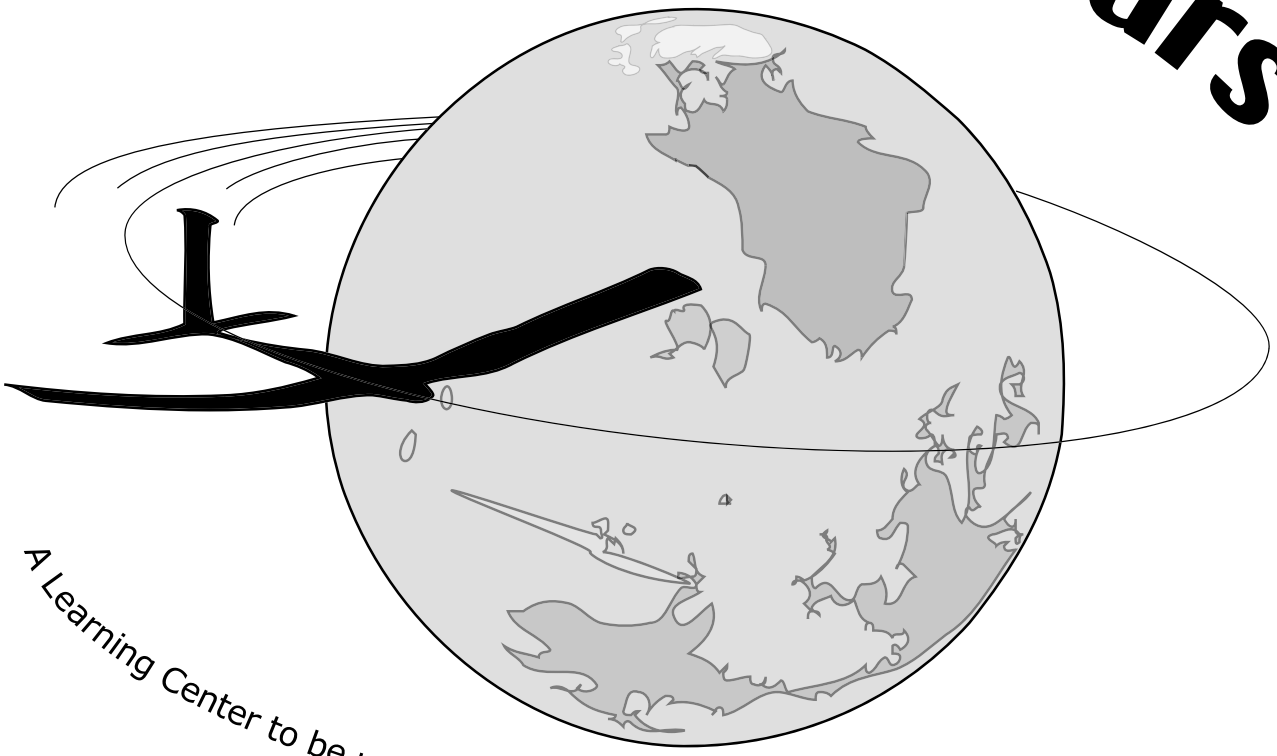
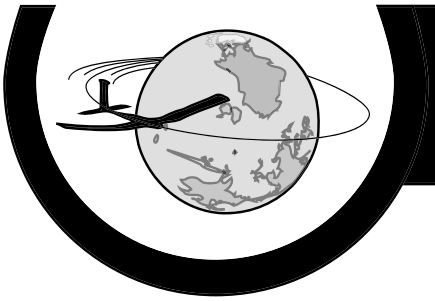
Moving to Mars



A Learning Center to be used in conjunction with **Mars: Virtual Exploration CD** and the tradebook ***Are We Moving to Mars?*** by Anne Schraff

Activities prepared by: Susanne Ashby

Graphic Design and Layout: Amberlee Chaussee



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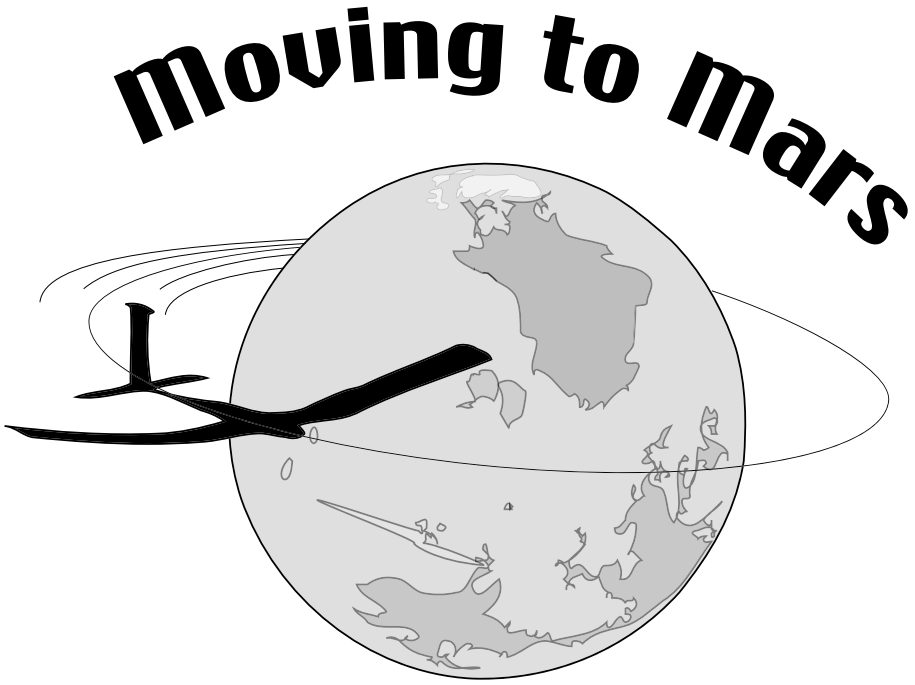
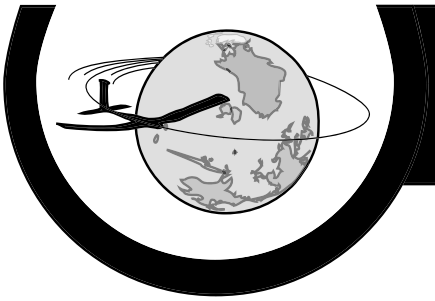


Reading Comprehension Questions

Student Comprehension Worksheets

Teacher Answer Keys for Worksheets



Student Comprehension Worksheets

Are We Moving to Mars?

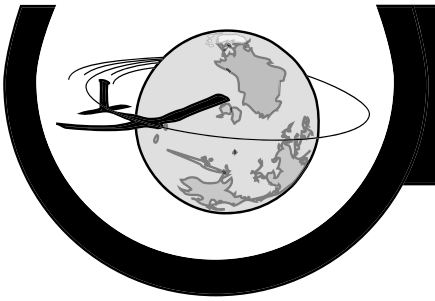
1. Looking at the two photos on pages 2 and 3, describe what Mars looks like to you.

2. What is this book going to examine?

What We Used to Think about Mars

3. Describe what some people thought a Martian looked like.

4. Give the nickname for Mars.



Student Comprehension Worksheets

What We Know Now

5. Complete the chart below.

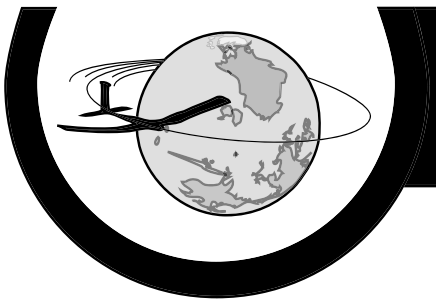
What We've Learned About Mars

Temperature	
Planet's Surface	
Water	
Life	
Air	
Gravity	

Terraforming: Creating Another Earth

6. In your own words describe terraforming.

7. How might scientists terraform Mars?



8. How many years do scientists believe it would take to terraform Mars?

Para-Terraforming: Speeding up the Process

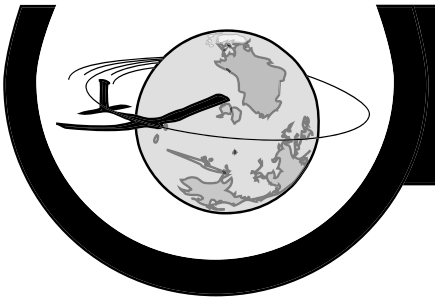
9. In your own words describe para-terraforming.

10. Describe one method scientists might use to para-terraform Mars.

Mars through the Ages

11. How did the planet Mars get its name?

12. Name one superstition that people had about Mars.



Student Comprehension Worksheets

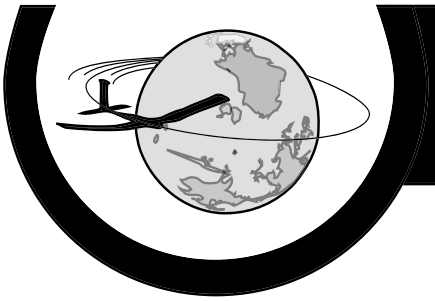
Scientists Search the Sky and The Martian Canal-Builders

13. Complete the chart below by giving the name of the scientist, the time he lived in and the discovery he made about Mars.

Scientists and Mars

Name of Scientist	Time Lived in	Discovery

14. List in your own words what Percival Lowell believed about Mars. (There were three mentioned in the reading.)



Student Comprehension Worksheets

Science Silences the Martian Rumors

15. How did other scientists react to Percival Lowell's beliefs about Mars?

16. What allowed scientists a better view of Mars?

17. What did scientists think about Mars after they got a better view?

Getting There: Why, When, How?

18. List the three reasons the author gives for going to Mars.

Our First Look at the Red Planet

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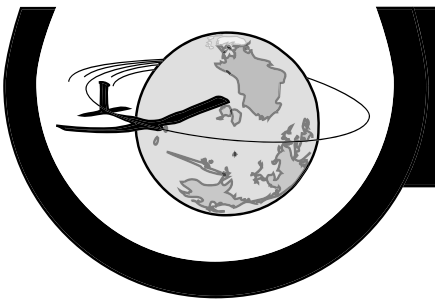

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Oh, What a Beautiful Morning!

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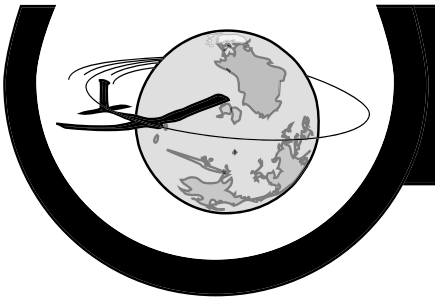

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Mars or Bust in 1997

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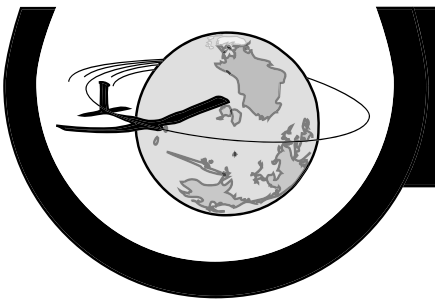
27. According to the reading, what is the mission of the Mars *Pathfinder*?

What Should We Expect on Mars? Is There Enough Water?

28. What does British scientist Dr. Richard Taylor believe about water on Mars?



Student Comprehension Worksheets

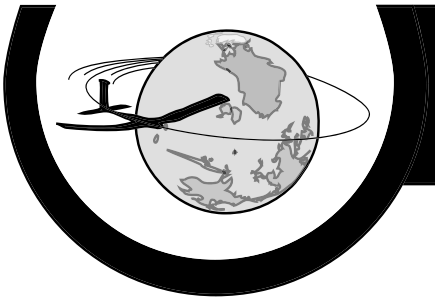
29. What do some scientists believe about water on Mars years ago?

Is There Enough Oxygen?

30. Describe the Martian atmosphere and what would be needed to breathe there.

Martian Winds Will Blow You Away

31. In your own words describe the wind speed, wind gusts and other wind hazards that are found on Mars.



Student Comprehension Worksheets

Terraforming: Making Mars a Second Earth

32. Name the chemical scientists believe would be most effective for creating a new atmosphere on Mars.

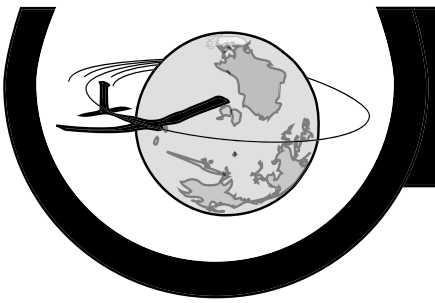
33. What would happen to the Martian atmosphere when this chemical was released on Mars?

34. Explain how scientists plan to release these gases into the Martian atmosphere?

Mirror, Mirror in the Sky

35. How do scientists plan to get more sunlight to the Martian surface?

36. Why would scientists want to add more sunlight to the Martian surface?



Student Comprehension Worksheets

Bombs Away!

37. Why would scientists interested in terraforming Mars want to explode bombs on its surface?

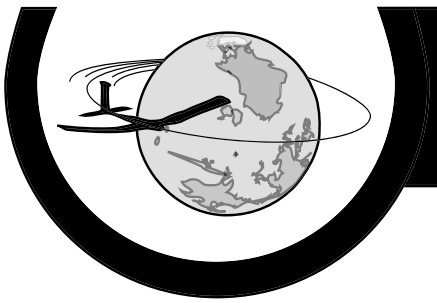
When Will Mars Look like Home?

38. How long do terraforming scientists predict it would take to warm up the atmosphere of Mars enough to begin growing simple plants?

39. In your own words describe one way that the process of terraforming could be done faster.

Para-Terraforming: Building Houses, Not Planets

40. Explain the difference between terraforming and para-terraforming for Mars.



Student Comprehension Worksheets

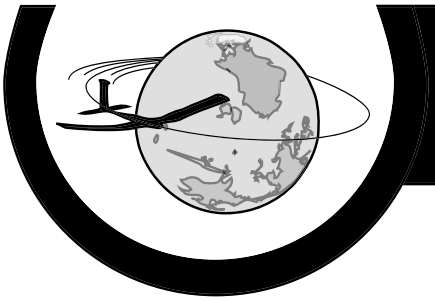
41. How do the scientists involved in the project Mars Habitation 2057 plan to para-terraform Mars?

Getting There

42. How long do scientists say it will take to travel to Mars?
How long for a round trip to Mars?

Starting out on the Red Planet

43. In your own words describe how Habitation 2057 will progress from 2020 - 2050.



Student Comprehension Worksheets

Main Street, Mars

44. Describe the homes that the scientists of Habitation 2057 want to build on Mars.

45. Describe the greenhouses that the scientists of Habitation 2057 want to build on Mars.

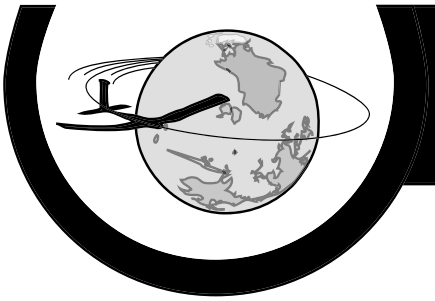
46. Describe the terrariums that the scientists of Habitation 2057 want to build on Mars.

47. What would the Martian settlers use the terrariums for?

An Independent Mars

48. Planners of Habitation 2057 predict that about 50,000 people will be living on Mars by 2100. What two things will they still need in order to survive the harsh Martian environment?

49. How do para-terraformers plan on making the Martian surface more hospitable?



Student Comprehension Worksheets

Welcome to Worldhouse!

50. In your own words describe Worldhouse.

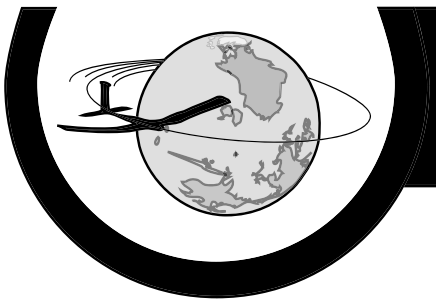
51. What geographic features on Mars would not be under the roof of Worldhouse?

Towers That Touch the Sky

52. What does IMAST stand for?

53. What would the IMAST be used for?

54. What does CTT stand for and what would these be used for?



Student Comprehension Worksheets

55. What would the unroofed parts of Mars be used for?

Working Together

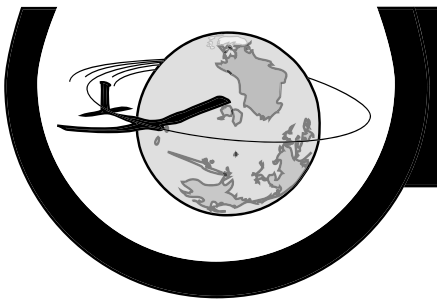
56. Since something like Worldhouse would be so expensive (billions of dollars), how could it be done?

Worldhouse Worries

57. How do the Worldhouse scientists plan to protect the roof from meteors?

The Critics Speak Out

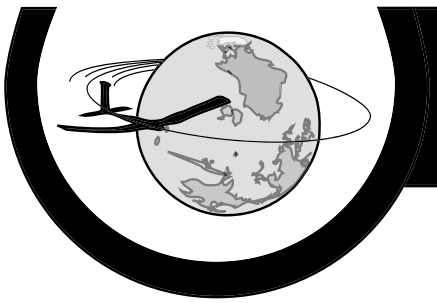
58. Give two of the arguments against Worldhouse, terraforming and para-terraforming.



Student Comprehension Worksheets

Where Do We Go from Here?

59. Give the one reason why some scientists believe humankind should colonize Mars.



Student Comprehension Worksheets – Key

Are We Moving to Mars?

1. Looking at the two photos on pages 2 and 3, describe what Mars looks like to you.

   Answers will vary, but they will probably include comments like: a red moon, a dusty red desert.

2. What is this book going to examine?

   The opinions of a few scientists who hope their dream of living on Mars become a reality (comes true).

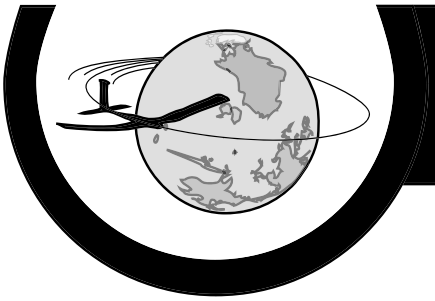
What We Used to Think about Mars

3. Describe what some people thought a Martian looked like.

   Answers will vary, but should contain some descriptors like: little bodies with spindly arms and legs, big heads because they are more intelligent than humans.

4. Give the nickname for Mars.

   The Red Planet.



Student Comprehension Worksheets – Key

What We Know Now

5. Complete the chart below.

What We've Learned About Mars

Temperature	can get down to 195 degrees below zero
Planet's Surface	desert
Water	no liquid water
Life	no sign of life
Air	too thin for humans to breathe
Gravity	low, about one-third that of Earth

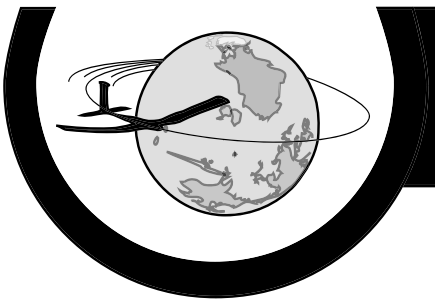
Terraforming: Creating Another Earth

6. In your own words describe terraforming.

Making another planet look and feel like Earth.

7. How might scientists terraform Mars?

Use giant space mirrors to reflect more sunlight to the Martian surface. Then explode powerful bombs to release water and minerals from the soil. Then wait for nature to take over.



Student Comprehension Worksheets – Key

8. How many years do scientists believe it would take to terraform Mars?

   As long as 10,000 Earth years.

Para-Terraforming: Speeding up the Process

9. In your own words describe para-terraforming.

   Building structures on Mars that are able to shelter people from Mars' harsh atmosphere (thin air and extreme cold).

10. Describe one method scientists might use to para-terraform Mars.

    1. *Build structures like enlarged spaceships.*
    2. *Build giant roofs over the planet with towering skyscrapers that rise two miles above the surface.*

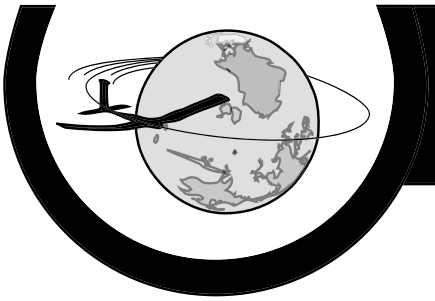
Mars through the Ages

11. How did the planet Mars get its name?

    Named after the Roman god of war, Mars. Probably because it was red, the color of blood like the blood that would be shed in battle.

12. Name one superstition that people had about Mars.

    In the 1800s people viewed the appearance of Mars in the sky as an omen of war.



Student Comprehension Worksheets – Key

Scientists Search the Sky and The Martian Canal-Builders

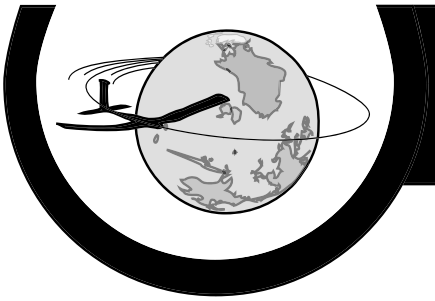
13. Complete the chart below by giving the name of the scientist, the time he lived in and the discovery he made about Mars.

Scientists and Mars

Name of Scientist	Time Lived in	Discovery
Aristotle	*300 BC*	*Mars farther from Earth than the moon.*
Herschel	*1771*	*Planet was similar in appearance to Earth (through telescope).*
Schiaparelli	*1877*	*Observed dark lines on the surface of Mars and called them "canali" or channels.*

14. List in your own words what Percival Lowell believed about Mars. (There were three mentioned in the reading.)

    1. *Martians were smarter than Earthlings because Mars is an older planet.*
    2. *Martians had inventions beyond our wildest imaginations that would amaze us.*
    3. *Martians used canals to bring water from the planet's polar ice caps to the dry regions near the equator.*



Student Comprehension Worksheets – Key

Science Silences the Martian Rumors

15. How did other scientists react to Percival Lowell's beliefs about Mars?

Some made fun of his ideas because they were not based on scientific facts.

16. What allowed scientists a better view of Mars?

Stronger telescopes gave scientists clearer views of the planet's surface.

17. What did scientists think about Mars after they got a better view?

They believed that there was no intelligent life on Mars nor was there any life on Mars. The canals might have held water at one time, but now they were permanently frozen glaciers.

Getting There: Why, When, How?

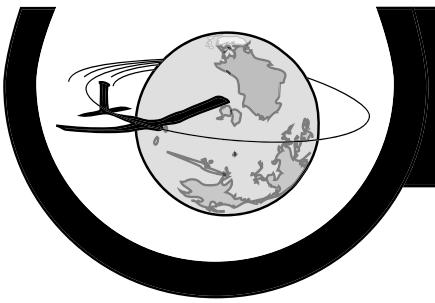
18. List the three reasons the author gives for going to Mars.

1. *To build a space station.*
2. *To learn more about ourselves.*
3. *To make a new home for us.*

Our First Look at the Red Planet

19. What major space exploration event happened in 1965?

The U.S. satellite "Mariner 4" orbited Mars and took the first close-up photos of Mars.



Student Comprehension Worksheets – Key

20. Why were scientists disappointed with the first close-up photos of Mars taken by the Mariner 4?

    The photos showed that Mars was a deserted, rocky place and that it looked more like the moon than Earth.

21. What major space exploration event happened in 1971?

    The U.S. satellite "Mariner 9" flew by Mars and took new photos of a different area.

22. What did the new photos reveal to scientists about Mars?

    These pictures showed that Mars had mountains that reached through the clouds, canyons ten miles deep and huge channels that once carried rushing water.

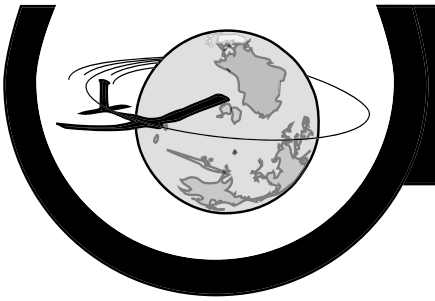
Oh, What a Beautiful Morning!

23. What major space exploration event happened in 1976?

    On July 30, 1976, "Viking I" became the first spacecraft to land on Mars.

24. What experiments did the *Viking I* spacecraft perform on Mars?

    Measured wind speeds and temperatures, photographed the sun shining on Mars' surface and collected rock samples.



Student Comprehension Worksheets – Key

25. What happened later in 1976?

"Viking II" landed in an area called the "Utopian Plains" near Mars' equator.

Mars or Bust in 1997

26. According to the reading, what two things are scheduled to happen in 1997?

1. *The "Mars Global Surveyor" will orbit the planet and take more photos.*
2. *The "Mars Pathfinder" satellite will send an automated rover (a remote-controlled, miniature dune buggy) to Mars.*

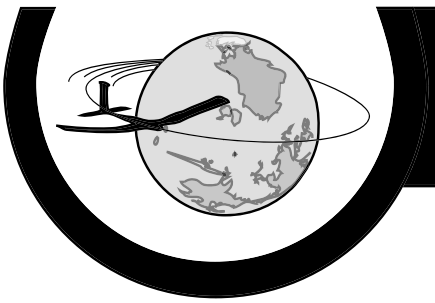
27. According to the reading, what is the mission of the Mars *Pathfinder*?

The mission of the "Mars Pathfinder" will be to find out whether water existed on Mars millions of years ago, and, if it did, where.

What Should We Expect on Mars? Is There Enough Water?

28. What does British scientist Dr. Richard Taylor believe about water on Mars?

He believes that there is enough water on Mars to support para-terraformers.



Student Comprehension Worksheets – Key

29. What do some scientists believe about water on Mars years ago?

Scientists guess that giant rivers once flowed through the Martian landscape about 4 billion years ago. They believe that some of Martian rivers flowed 100 times faster than the Amazon River.

Is There Enough Oxygen?

30. Describe the Martian atmosphere and what would be needed to breathe there.

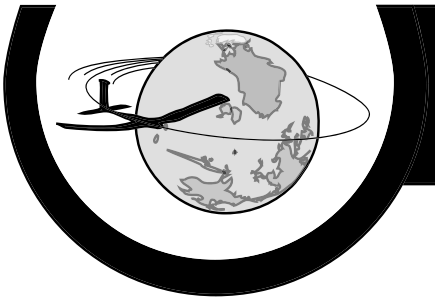
The atmosphere on Mars has only a fraction of the amount of oxygen that humans need to live. We would need oxygen masks to live there.

Martian Winds Will Blow You Away

31. In your own words describe the wind speed, wind gusts and other wind hazards that are found on Mars.

Winds blow about 16 miles per hour most of the time.
They can also blow up to 73 miles per hour.

When the wind blows it creates dust storms that can take months to settle. Huge, planet-wide dust storms occur in the spring and summer, when Mars is closest to the sun.



Student Comprehension Worksheets – Key

Terraforming: Making Mars a Second Earth

32. Name the chemical scientists believe would be most effective for creating a new atmosphere on Mars.

    CFCs = chlorofluorocarbons

33. What would happen to the Martian atmosphere when this chemical was released on Mars?

    It would create a "runaway greenhouse effect." That means the atmosphere becomes thicker and starts holding in more heat.

34. Explain how scientists plan to release these gases into the Martian atmosphere?

    Build chemical factories on Mars which will pump gases into the atmosphere.

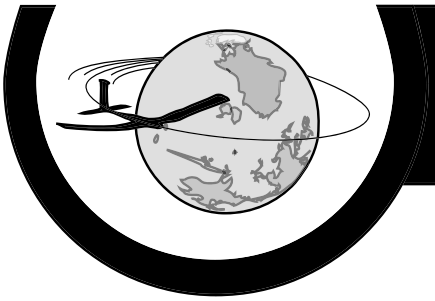
Mirror, Mirror in the Sky

35. How do scientists plan to get more sunlight to the Martian surface?

    Create floating space mirrors made of large sheets of foil that would orbit Mars.

36. Why would scientists want to add more sunlight to the Martian surface?

    It would warm the surface of Mars more quickly and the temperature on the surface would become more bearable.



Student Comprehension Worksheets – Key

Bombs Away!

37. Why would scientists interested in terraforming Mars want to explode bombs on its surface?

    These bombs would cause tremendous underground explosions that would force water out of the ground and help to slowly warm up the planet.

When Will Mars Look like Home?

38. How long do terraforming scientists predict it would take to warm up the atmosphere of Mars enough to begin growing simple plants?

    They believe it will take thousands of years, more than 10,000 years.

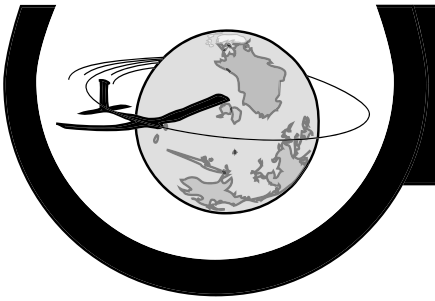
39. In your own words describe one way that the process of terraforming could be done faster.

    Colonists living on Mars terraform it after they get there.

Para-Terraforming: Building Houses, Not Planets

40. Explain the difference between terraforming and para-terraforming for Mars.

    To terraform Mars it would mean to make the entire planet just like Earth. To para-terraform Mars it would mean building structures over parts of Mars where humans would live comfortably while the rest of the planet remains as it was.



Student Comprehension Worksheets – Key

41. How do the scientists involved in the project Mars Habitation 2057 plan to para-terraform Mars?

    They will build a settlement of hundreds of inflatable small houses, domes for recreation and greenhouses for crops.

Getting There

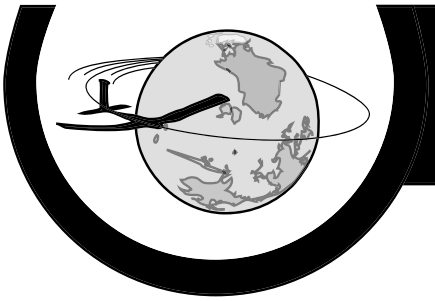
42. How long do scientists say it will take to travel to Mars?
    How long for a round trip to Mars?

    Eight months to get there.
    Two years for a round trip.

Starting out on the Red Planet

43. In your own words describe how Habitation 2057 will progress from 2020 - 2050.

    1. *6 - 12 experienced astronauts land on a plain near the Martian equator.*
    2. *Raise a tent-like, inflatable shelter.*
    3. *During the first ten years these astronaut/scientists will study the planet and learn how to live in this environment.*
    4. *Flights between Earth and Mars will take place every other year.*
    5. *By 2050, 50 explorers will be living on a base using a solar-powered satellite for energy.*



Student Comprehension Worksheets – Key

Main Street, Mars

44. Describe the homes that the scientists of Habitation 2057 want to build on Mars.

Aluminum buildings about as large as big apartments.

45. Describe the greenhouses that the scientists of Habitation 2057 want to build on Mars.

Inflatable and shaped like sausages cut in half.

46. Describe the terrariums that the scientists of Habitation 2057 want to build on Mars.

Inflatable, dome-shaped buildings about as big as a sports stadium.

47. What would the Martian settlers use the terrariums for?

They would use it to stroll around in a nature setting similar to Earth. It would be a park-like setting for humans to rest, relax, talk and walk through.

An Independent Mars

48. Planners of Habitation 2057 predict that about 50,000 people will be living on Mars by 2100. What two things will they still need in order to survive the harsh Martian environment?

1. *Oxygen*
2. *Spacesuits to protect them from the harsh environment.*

49. How do para-terraformers plan on making the Martian surface more hospitable?

Great buildings whose tops will support a roof over Mars.

Student Comprehension Worksheets – Key

Welcome to Worldhouse!

50. In your own words describe Worldhouse.

A two-mile high, gas-tight roof suspended from a large tower.

51. What geographic features on Mars would not be under the roof of Worldhouse?

1. *North Pole*
2. *South Pole*
3. *Olympus Mons*
4. *Valles Marineris*

Towers That Touch the Sky

52. What does IMAST stand for?

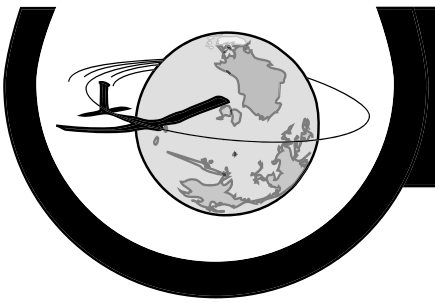
Inhabited Mars Tower Roof Support

53. What would the IMAST be used for?

It would be a huge skyscraper that would function like a vertical city that would be home to 500,000 people.

54. What does CTT stand for and what would these be used for?

Compression Tension Tower: slender the same height as the IMAST 11,480 feet tall used to hold up sections of the roof.



Student Comprehension Worksheets – Key

55. What would the unroofed parts of Mars be used for?

    Mining and solar power plants.

Working Together

56. Since something like Worldhouse would be so expensive (billions of dollars), how could it be done?

    Countries working together.

Worldhouse Worries

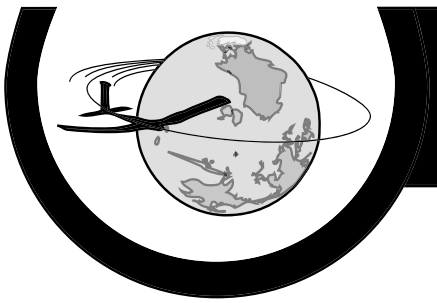
57. How do the Worldhouse scientists plan to protect the roof from meteors?

    Intercept the meteors before they hit the roof with a rocket that would destroy it or change its course.

The Critics Speak Out

58. Give two of the arguments against Worldhouse, terraforming and para-terraforming.

    1. *Don't know enough about Mars to undertake any major projects in the near future.*
    2. *Do the benefits outweigh the cost?*
    3. *Since we don't understand our own environment very well, how can we hope to understand Mars'?*
    4. *The roof would cost a fortune to maintain and any explosion would leave such a hole that the whole atmosphere would be destroyed before the hole could be sealed.*

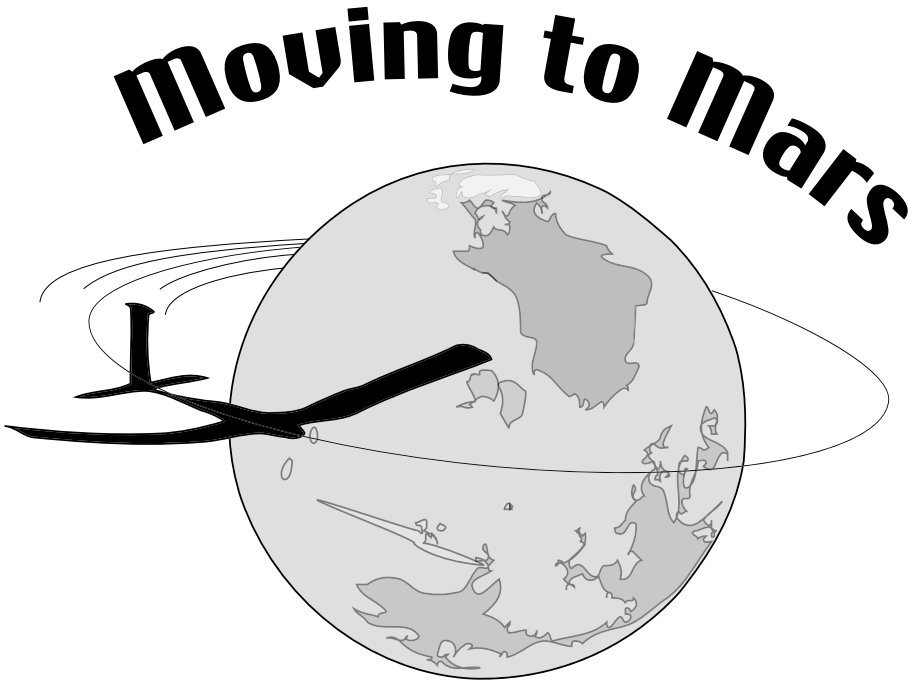


Student Comprehension Worksheets – Key

Where Do We Go from Here?

59. Give the one reason why some scientists believe humankind should colonize Mars.

    1. *To make sure the human race survives in case of a huge catastrophe on Earth.*



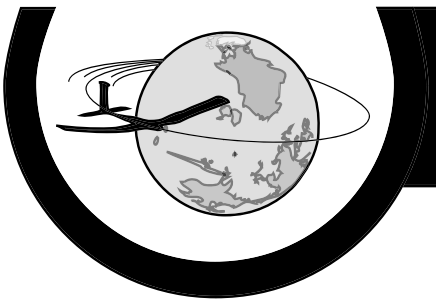
Drawing Diagrams

Spacecraft to Mars

Underground Martian House

M.A.T.T. (Martian All Terrain Transport)

First Colony on Mars



Drawing Diagrams

Teacher Suggestions

1. Any of the diagram drawing assignments can be converted into a 3-D model creation. Simply require students to label special sections or parts with numbers and include a key that explains the importance of each.

2. Prior to distributing the student guidesheets for any of the diagram drawings, the teacher should pose a few questions to generate a class discussion and/or brainstorming session to set the stage. Below is a brief guide to initiating such discourse amongst the students prior to beginning the assignment.

   Spacecraft to Mars

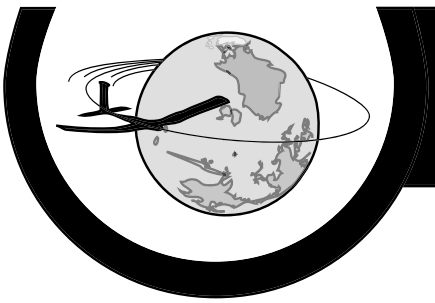
   Before designing a spacecraft which will take the first colonists to Mars, we need to ask ourselves, "What kind of things will the colonists need take with them?" These things should not just be for the trip, but also to help them get their colony started. Let's make a list of the things the colonists will need. Should we place them in categories or just list? (Possible categories: Things to use during trip / things needed to start colony). Work with students to develop a list of about twenty items to get them going.

   Underground Martian House

   The author of the book informed us that houses built on Mars would need to be underground. She gave us three reasons why. Does anyone remember one of them?
   List them:
   - protection against strong winds
   - protection against freezing temperatures
   - protection against the sun's harmful rays

   Since these houses would be underground, do you think they need to be designed differently from the houses on Earth? Why do you think so? What kind of design features do we need to do differently for the Martian underground homes?

   Have the students generate a list. Let them know they can use some of these ideas in their diagram of an underground Martian house.



Drawing Diagrams

Teacher Suggestions

M.A.T.T. (Martian All Terrain Transport)

Since the features on Mars are different from those on Earth we have to re-design the vehicles that will drive on Mars. Remember that the gravity on Mars is not as great. How would that affect our new design? It could be heavier than the vehicles on Earth because on Mars they would actually be lighter. There is a lot of dust and rocks of all shapes and sizes, not to mention craters, deep channels and large mountains. How would these features affect our design? Entertain thoughts that deal with tire size, height of vehicle off the ground, type of traction (other than tires), suspension system, steering, and driver compartment. Since there are no gas stations, how would that affect the design for fuel and fuel storage? Entertain ideas about some type of solar power or perhaps Martian dust for fuel.

First Colony on Mars

A colony on Mars will look different from any other Earth colonies that were built during the history of Earth. When the colony is first started, the colonists will be able to build only the essential (most needed) buildings to survive. Later they could build other buildings that they found out they needed or wanted for recreational reasons.
Let's name what some of the essential buildings might be. Be sure to tell me why you think it would be an "essential" building.

The following list could then be generated (with explanations) by the students.

- power station
- water station
- air station (ventilation system)
- communication station
- waste disposal system
- domed farm
- science lab
- medical facility
- vehicle storage
- food storage
- warehouse
- large group home

Drawing Diagrams

Teacher Suggestions

Spacecraft to Mars

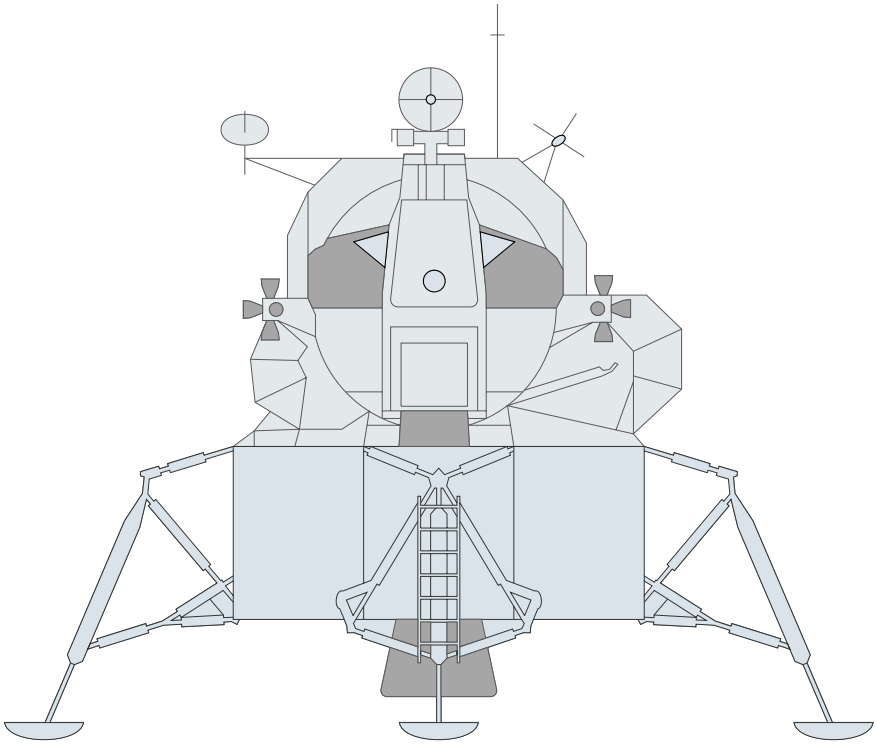
To travel from Earth to Mars it will take about eight months. Your spacecraft must be large enough to carry more than just passengers and crew. It will need to carry or be able to support on board food and energy (for propulsion as well as maintaining life support). This food and energy must last well into the time it will take the colonists to set up camp and get the colony started. The spacecraft to Mars will also need to be able to carry building materials, machinery, replacements parts, construction equipment, scientific equipment and other tools. It must carry medical equipment and supplies as well as personal items and luggage of the colonists. It will also need storage space for vehicles that will be used on the planet's surface. These are just some of the items that will be needed not only to make the trip, but also to use on Mars.

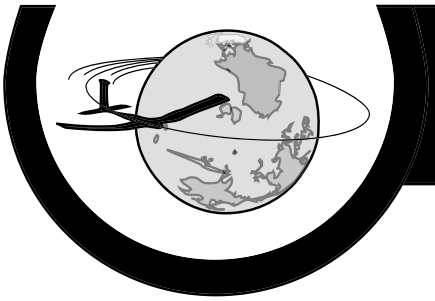
Design the spacecraft that will take the colonists to Mars. Keep in mind not only what it needs to carry, but what it needs to be able to do during the trip. Create two drawings of your spacecraft. Make one a view of what the spacecraft will look like from the outside. Make the other diagram a cross section showing the different compartments. Don't forget to label the compartments, parts or sections of your spacecraft.

See the NASA lunar lander on the next page for an example.

Drawing Diagrams

Lunar Lander Diagram Example





Drawing Diagrams

Underground Martian House

In the book Are We Moving to Mars? by Anne Schraff, the author talks about the types of houses which could be built on Mars. The author tells us that to protect the colonists against the sun's harmful rays, the strong winds and freezing temperatures on Mars, the houses must be built underground. How would these houses then be different from the homes on Earth? Would a house on Mars be designed differently because it is underground? In what ways would it need to be different? Don't forget to think about how to get air into the home and circulate it through the house. How would your waste products be disposed of? Would the rooms need to be bigger? Would you need special lighting?

Design your own Martian house. Use a cross section diagram that shows the layout under the ground. Label each room and give any additional details for any special equipment that you might have in your Martian house that would not be needed in a house on Earth.

See the diagram below for an example.

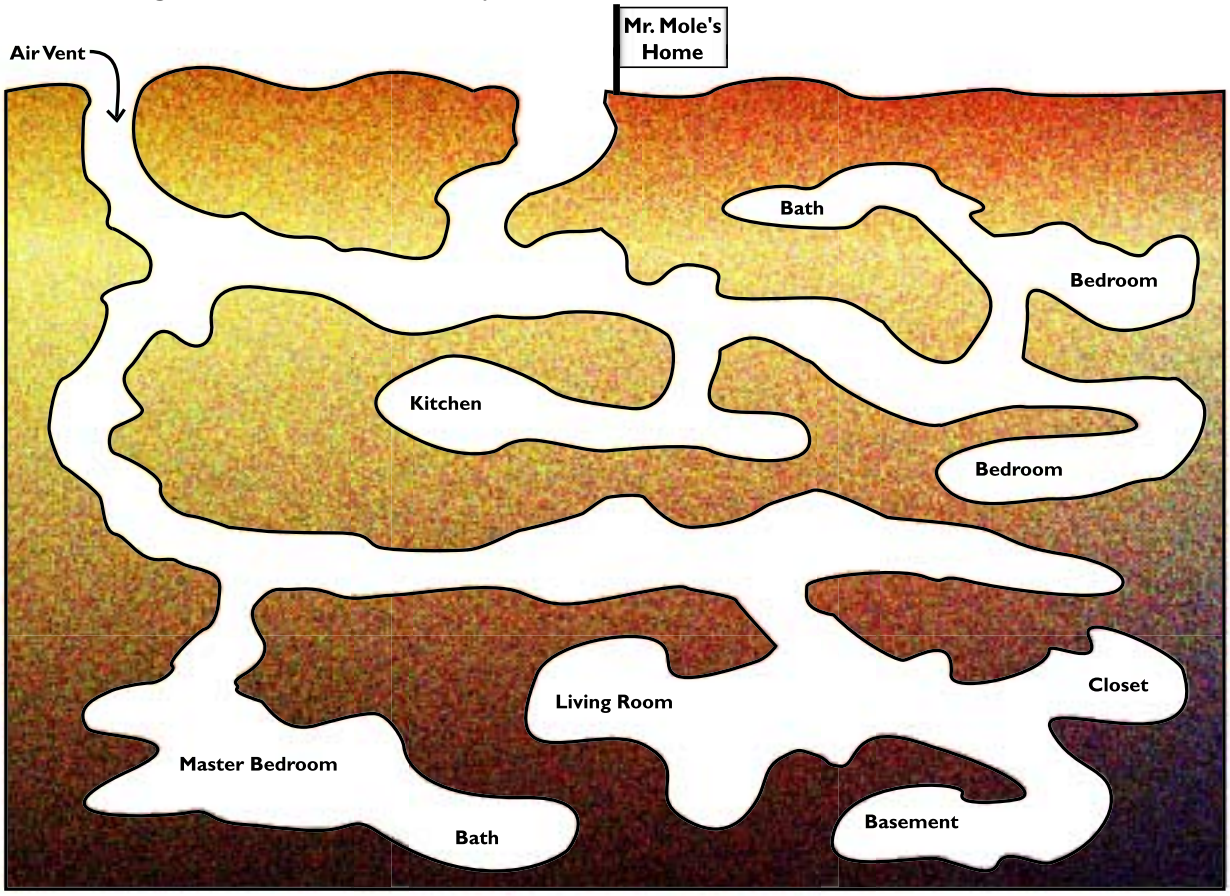
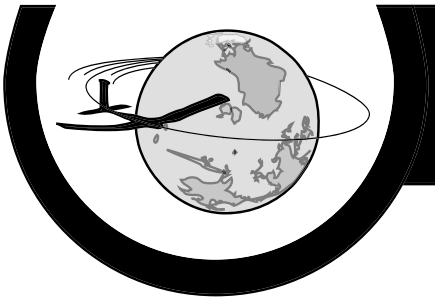


Illustration by: Andrew Doser



Drawing Diagrams

M.A.T.T.*
*Martian All Terrain Transport

While living on Mars the colonists will need transportation to move around on the planet's surface. This vehicle will need to be different from cars or trucks on Earth because there will be no paved roads for awhile. This vehicle will need to be able to protect the driver and passengers from the harsh Martian environment. Because you won't be able to bring lots of different types of vehicles you might want to consider making this a multipurpose vehicle. That means it can be used for more than just one type of driving.

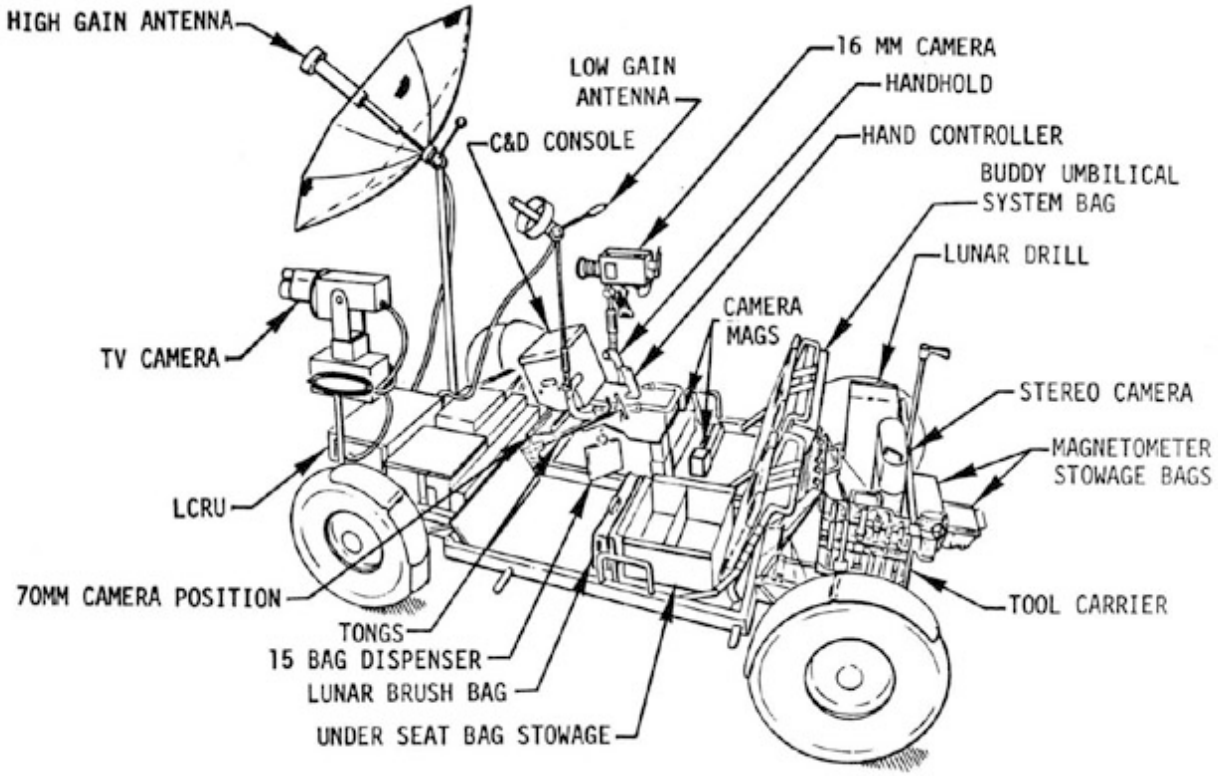
It should be able to carry more than people. It should be able to carry heavy equipment, medical supplies, emergency supplies, scientific equipment and spare parts. It should be strong enough to pull a trailer, yet be able to easily move around large obstacles and drive right over small ones. It should be able to drive up and down steep inclines without tipping over. Its fuel and power supply must be able to last for long distances and possibly overnight stays. What if you would get caught in a major dust storm and be unable to drive because you could not see where you were going? With that in mind, should it then be able to convert into comfortable sleeping quarters for overnight stays?

Create a diagram of a M.A.T.T.* Include a view from the outside and label any of its special equipment or features. Tell what each would be used for. Then create a cross section diagram that shows the inside of the vehicle. Label all the compartments, sections and special equipment and tell what they would be used for.

Look at the diagram on the next page of the Lunar Rover as an example.

Drawing Diagrams

Lunar Rover Diagram

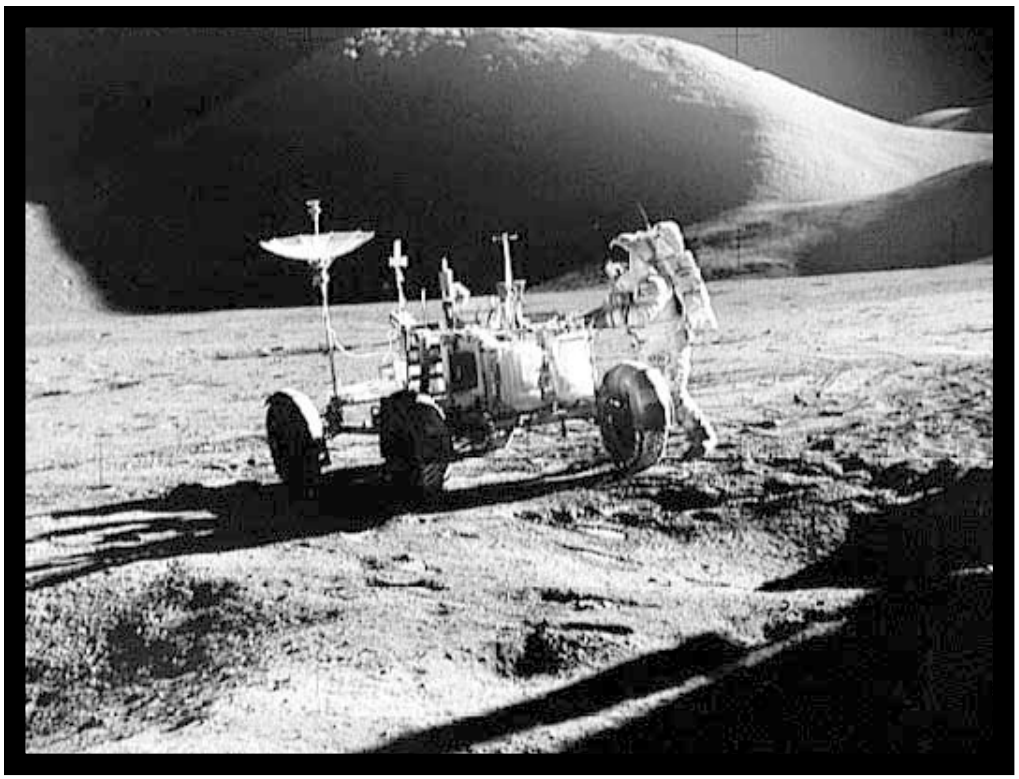


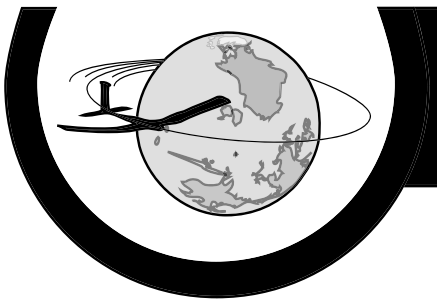
The LRV was ten feet, two inches (310 cm) long; had a six-foot (183 cm) tread width; was 44.8 inches (114 cm) high; and had a 7.5-foot (229 cm) wheelbase. Each wheel was individually powered by a quarter-horsepower electric motor (providing a total of one horsepower) and the vehicle's top speed was about eight miles per hour (13 km/hr) on a relatively smooth surface.

Two 36-volt batteries provided the vehicle's power, although either battery could power all vehicle systems if required. The front and rear wheels had separate steering systems, but if one steering system failed, it could have been disconnected and the vehicle would have operated with the other system.

Drawing Diagrams

Lunar Rover Vehicles (LRV) used on the Apollo 15 and Apollo 17 missions.





Drawing Diagrams

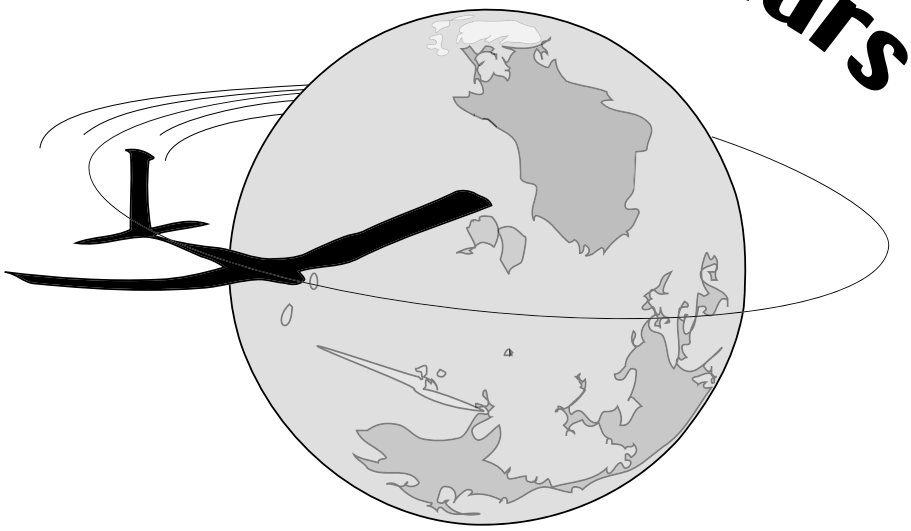
The First Colony on Mars

The first colony on Mars would probably have only the essentials needed to survive. The colonists must be able to set up the structures quickly, yet be well protected from the harsh living conditions on Mars. The colony will need to be self-supporting as soon as possible. Though small at first, the colony will need to be able to grow and expand as more people arrive and more structures are needed.

For this assignment you will create two diagrams. You will first design your vision of what the first colony on Mars would look like. Then look ten years into the future of that colony and diagram what it would look like later. How would it change in ten years' time? Besides more people and buildings, how else would it change?

Use the space below for a rough draft before you make your two final diagrams.

Moving to Mars

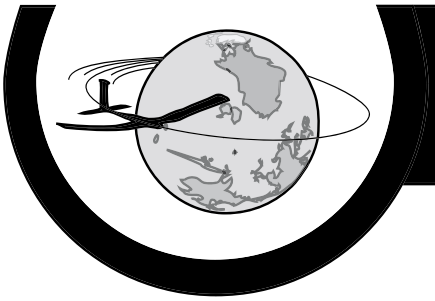


Writing Activities

Writing a Ballad Stanza

Design a Poster

Interplanetary Laser Relay Mail



Writing Activities

Ballad Stanza

The ballad stanza has four lines grouped together. The second line and the fourth line rhyme. The syllable count for each line with the rhyme pattern are listed below.

Line 1	8 syllables	does not rhyme with any other line
Line 2	6 syllables	rhymes with only line four
Line 3	8 syllables	does not rhyme with any other line
Line 4	6 syllables	rhymes with only line two

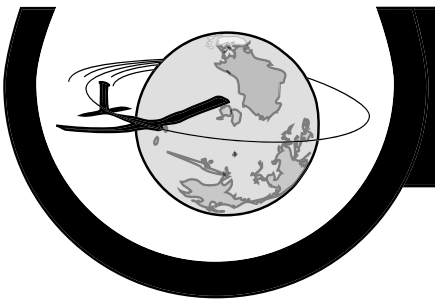
Read the ballad stanza below which talks about the geographic features of Mars.

The Face of Mars

Red and dusty, scattered with rocks;
Capped by poles in cold sleep.
Rise through the clouds Olympus Mons;
Cut by channels so deep.

Write a ballad stanza (or more) about one of the following Mars topics:

1. Terraforming
2. Para-Terraforming
3. Worldhouse
4. Living on Mars
5. The Martian Landscape



Writing Activities

Design a Poster

Posters are used today for many purposes. Posters are used to advertise new products and to tell people about events like concerts, garage sales or houses for sale.

Posters are usually designed with the most important point in the largest typeface. The other details which are a little less important than the main idea are included next in slightly smaller typeface. That information is then followed by the name and phone number of the person or agency to contact if the reader wants to know more. The contact information is usually found at the bottom of the poster. Somewhere on the poster is a graphic that would catch the reader's eye.

Design a poster that tells people about the need for colonists on Mars and asks people to volunteer to colonize Mars. Make sure you include the following information:

- a statement or question about colonizing Mars
- details such as the
  - environment
  - homes
  - types of jobs
- person or agency to contact
- a graphic

Design a Poster Example

Use the example below to help you design your poster advertising for colonists to colonize Mars.

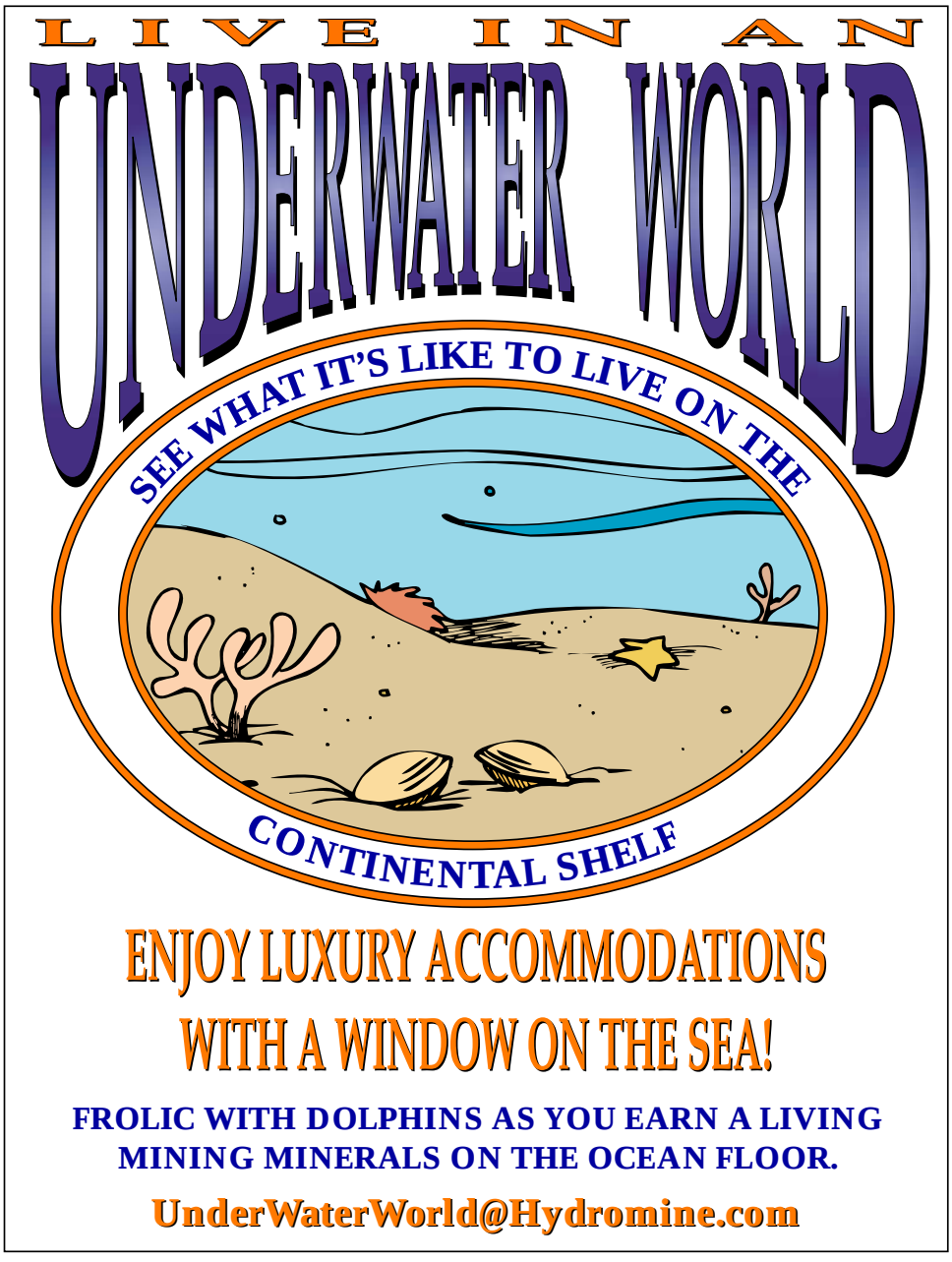
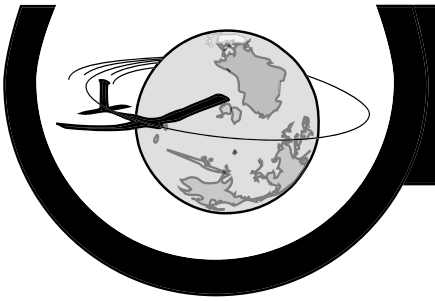


Illustration by: Andrew Doser



Interplanetary Laser Relay Mail

You and your family have been living on a mining colony on Mars for the last two months. Your home computer has finally been connected to the laser satellite dish. This will allow you to send messages to your friends on Earth. You are excited about the opportunity to finally get to tell your friends about life on Mars.

An Interplanetary Laser Relay Mail message will probably not be as formal as a letter, but could include the information found in the example below.

Receiver: **name * satellite station number ***

Sender: **your name * mars.l-sat.ares-val***

Mars Date / Time: _____

Earth Date / Time: _____

Greeting:

Requests:

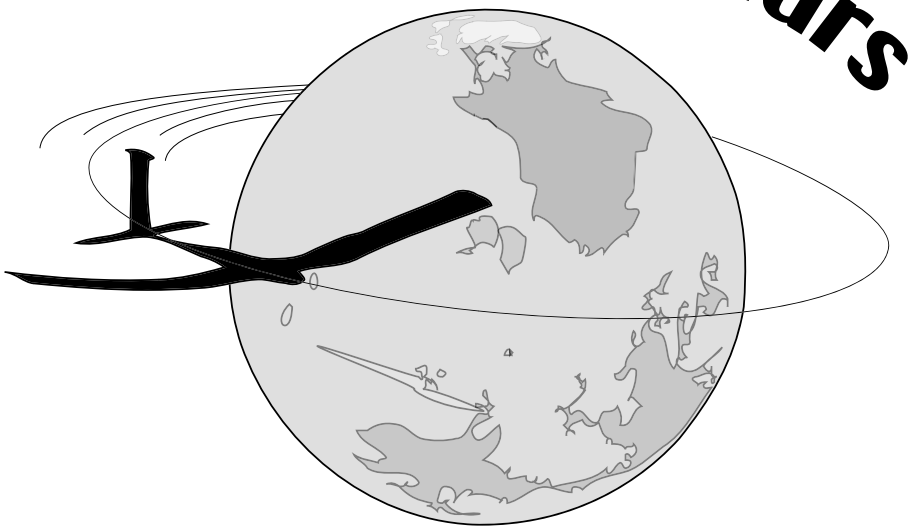
Message:

Sentiments:

Closing:

Now, create your own version of a futuristic mail message that could be used to send interplanetary messages. Then complete the form with information about your first month on Mars.

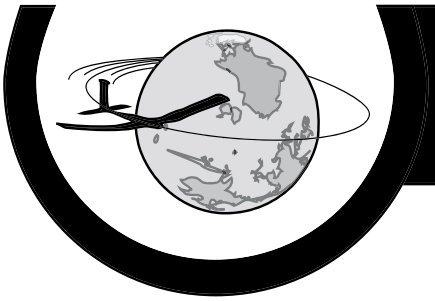
Moving to Mars



Problem Solving

Protection from Meteorite Impacts

Garbage Disposal and Recycle



Problem Solving

Protection from Meteorite Impacts

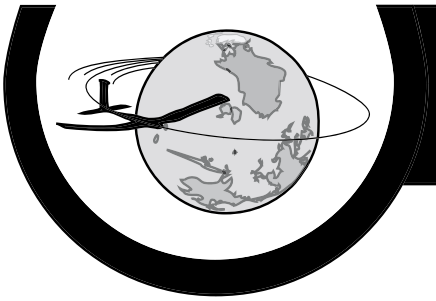
Because our earth is surrounded by a thick blanket of air, we are protected from a large amount of meteorite impacts. Many of the meteors which get pulled toward the Earth by the Earth's gravitational pull burn up before ever reaching the surface. Since the atmosphere of Mars is much thinner, Mars has many more meteorite strikes than Earth. This will be a serious concern of the colonists on Mars. A meteorite shower could cause a great amount of damage to the structures built on Mars. Before humans can safely colonize Mars, this problem needs to have a solution.

To solve this problem your group of scientists and engineers might have to create new technologies that will enable them to solve the problem. This will take some creative thinking!

Review the solution found in the book. Meet with your group and develop one solution that will protect the colonists who will live on Mars and the structures that will be built on Mars. Complete the chart below and make a diagram of your solution on the back of this page. Be prepared to share your solution with the class.

Meteorite Impact Solution

Brief Description of Solution	
New Technology that Needs to be Created	
Other Concerns	



Problem Solving

Garbage Disposal and Recycle

One of the concerns we have on Earth is the large amount of garbage we must some how get rid of. We need better solutions for reusing or recycling our garbage here on Earth before we can move to Mars.

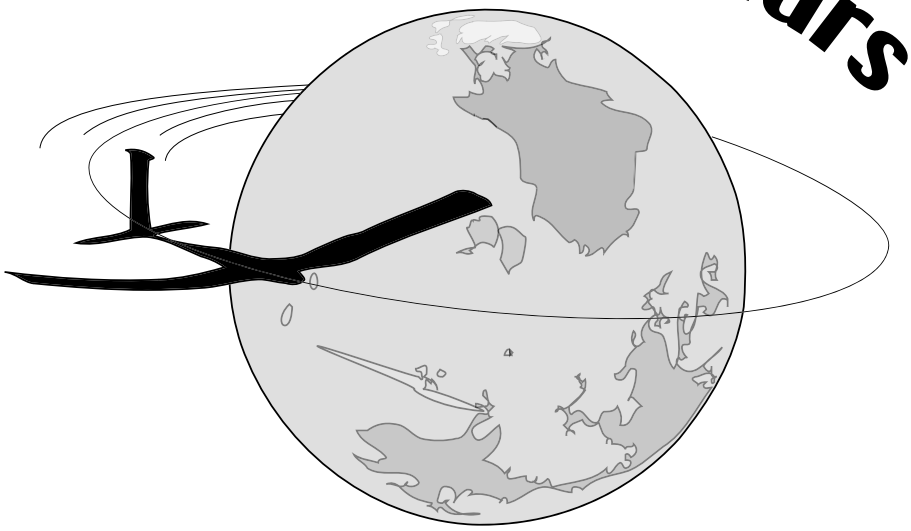
Meet with your team of scientists, engineers and waste disposal experts to come up with a solution for this problem. In order to solve this problem you might need to create new technologies that will help you solve the problem. You might also want to consider restrictions on what kind of packaging products should be made of. This would help during the recycling process.

Complete the chart below and be prepared to share your solution with the class.

Garbage Disposal and Recycle Solution

Brief Description of Solution	
New Technology that Needs to be Created	
Recycling Component	
Other Concerns	

Moving to Mars



Note Taking

Reading Selection Note Taking Guide

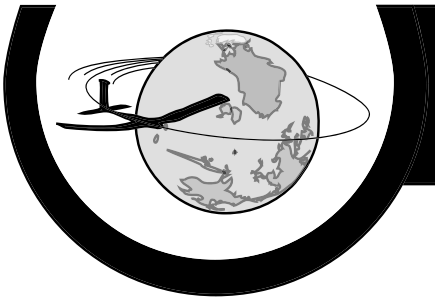
Reading Selection Note Taking Answer Keys

What We Know Now

Terraforming: Creating Another Earth

Para-terraforming: Speeding up the Process

Scientists Search the Skies



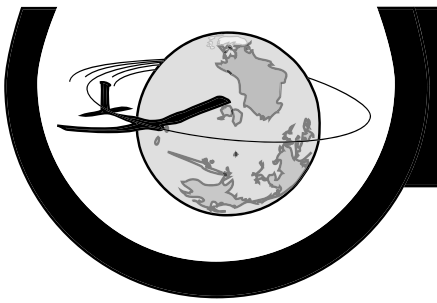
Note Taking

Note Taking from a Science Reading

Choose two sections from the book Are We Moving to Mars? which are listed below and re-read them. Then use the guidesheet on the next page and take notes on your two sections. Be sure to include only the important big ideas and two to four of the important little details for each. Remember when taking notes you do not need to use complete sentences. Short phrases that describe the big ideas and the details are enough. If you feel a diagram would be helpful, you could sketch one in under the big idea column.

Choose two from below.

- What We Know Now
- Terraforming: Creating Another Earth
- Para-terraforming: Speeding Up the Process
- Scientists Search the Skies



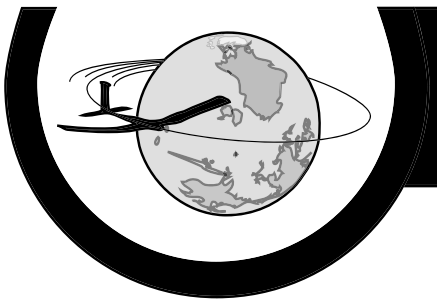
Note Taking

Are We Moving to Mars?

Note Taking Guide

Section Title: _____

Big Ideas	Important Little Details

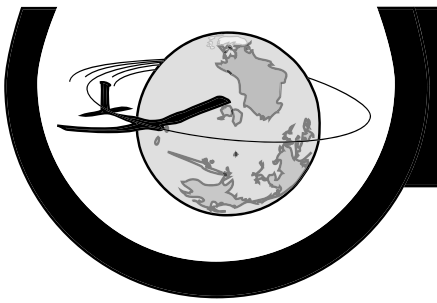


Are We Moving to Mars?

Note Taking Guide

Section Title: <u>What We Know Now</u>

Big Ideas	Important Little Details
Mars not like Earth	• Temperature down to 195 degrees below zero • air is too thin to breathe (not enough oxygen) • desert planet • no liquid water • no sign of life • gravity is low



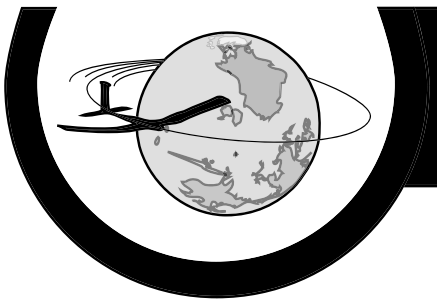
Note Taking

Are We Moving to Mars?

Note Taking Guide

Section Title: **Terraforming: Creating Another Earth**

Big Ideas	Important Little Details
Terraforming	• making a planet look & feel like Earth • Venus is too different from Earth & can't be terraformed
Terraforming Mars	• Mars is cold • atmosphere 1/100 as dense as Earth's • make it more breathable by shooting special gases into atmosphere • use giant mirrors in space to reflect more sunlight to the surface to warm it up • explode powerful bombs to free up the water and minerals from the soil • would take 10,000 years to make it like Earth



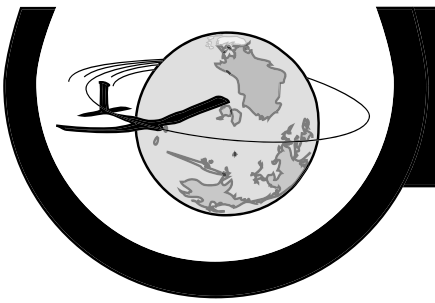
Note Taking

Are We Moving to Mars?

Note Taking Guide

Section Title: **<u>Para-Terraforming: Speeding Up the Process</u>**

Big Ideas	Important Little Details
Para-terraforming	• building structures on Mars that shelter people against the planet's harsh surface • structures could look like enlarged spaceships • another idea is to build giant roofs over the planet that is held up by tall skyscrapers 2 miles high



Note Taking

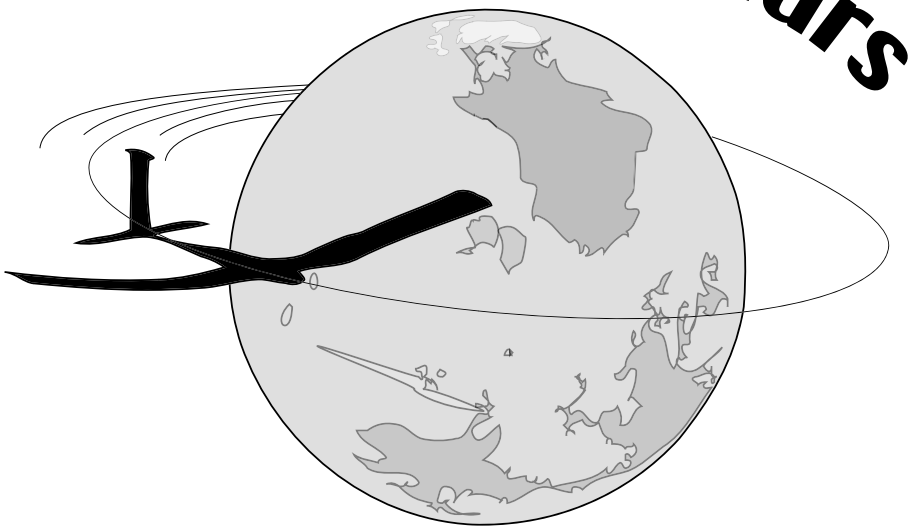
Are We Moving to Mars?

Note Taking Guide

Section Title: <u>Scientists Search the Skies</u>

Big Ideas	Important Little Details
Aristotle	• Greek lived 2,300 years ago • gave first scientific opinion about Mars • noticed Mars disappeared behind the moon • that means it was farther away from Earth than the moon
Galileo	• invented the telescope 1609 • could observe Mars more closely
Herschel	• studied Mars in 1771 • was convinced that Mars was like Earth and could support life • this led to wacky theories about Mars

Moving to Mars

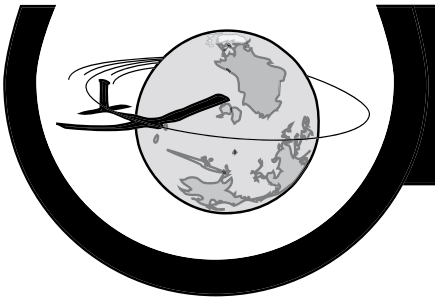


Research Projects

Mars Factoid Mobile

Discoveries of Mars Timelines

Discoveries of Mars Timeline Answer Key



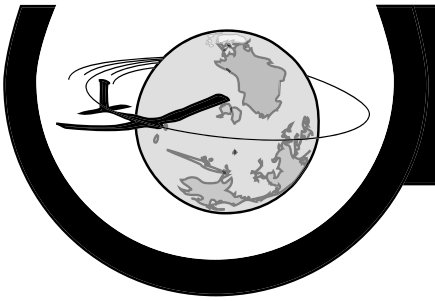
Research Projects

Mars Factoid Mobile

Using Web resources or book references do some additional research about Mars and its two moons, Phobos and Deimos. Use the note taking chart below to help you organize your information.

After you gather the information create two or three dimensional graphics to hang together for a Mars Mobile. Try to use more graphic images than text to present the information. Be creative in your use of graphics!

FACTOID	MARS	PHOBOS	DEIMOS
origin of name			
type of space object			
place in solar system			
size (diameter)			
surface features			
discovery (year & person)			
other interesting factoid			



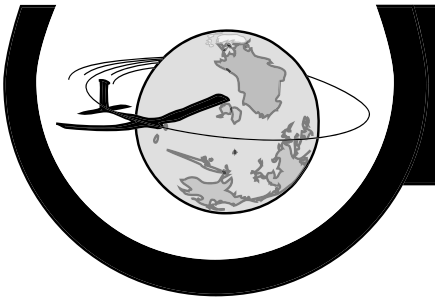
Research Projects

Mars Factoid Mobile

Using Web resources or book references do some additional research about Mars and its two moons, Phobos and Deimos. Use the note taking chart below to help you organize your information.

After you gather the information create two or three dimensional graphics to hang together for a Mars Mobile. Try to use more graphic images than text to present the information. Be creative in your use of graphics!

FACTOID	MARS	PHOBOS	DEIMOS
origin of name	*Roman god of war*	*fear*	*terror*
type o space object	*planet*	*satellite*	*captured asteroid*
place in solar system	*4th from sun*	*orbits Mars*	*orbits Mars*
size (diameter)	*6,780 km = 4,217 miles*	*27 x 21.5 x 19 km*	*11 x 12 x 15 km*
surface features	*red dust & rocks mtns./volcanoes channels, canyons, polar ice caps*	*craters, elongated depressions, linear striations, chains of crates*	*sprinkled with craters*
discovery (year & person)	*Chinese & Greeks B.C.*	*Asaph Hall 1877*	*Asaph Hall 1877*
other interesting factoid	*answers will vary*	*answers will vary*	*answers will vary*



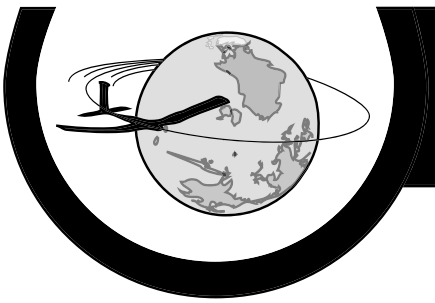
Research Projects

Discoveries about Mars Timeline

Even though Mars was noticed in the sky by the Chinese thousands of years ago, our knowledge of Mars has grown only little by little through the ages. As technology improved (first with the invention of the telescope and later with satellites) greater and greater amounts of information about Mars have been gathered by scientists.

Beginning with the Chinese and the Greeks (namely Aristotle) research the important discoveries made about Mars through the centuries. Below is a list of some important people or programs that have gathered new information about Mars. As you research these names, look for additional information on important discoveries.

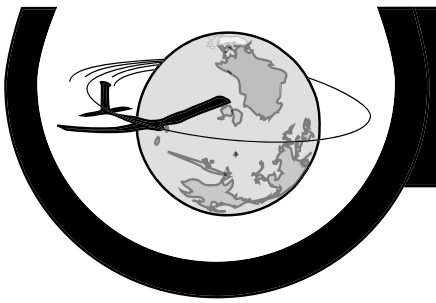
Aristotle	**Viking Missions**
William Herschel	**Mariner Missions**
Giovanni Schiaparelli	**Johannes Kepler**
Percival Lowell	**Galileo Galilei**
Asaph Hall	**Mars Observer**
Mars Global Surveyor	**Mars Pathfinder**
Phobos 1 & 2	**Mars Sojourner**
Mars Surveyor '98 Orbiter	**Mars Surveyor '98 Lander**



Research Projects

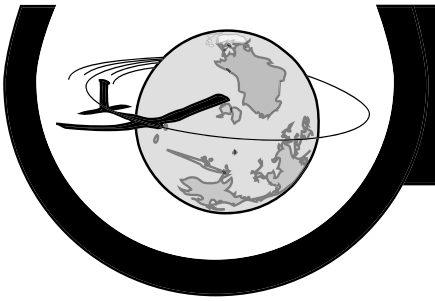
Then create and illustrate a timeline that shows when these important discoveries took place, who made them and what information was gathered.

Person / Program	Year	Information Gathered
Chinese		
Aristotle		
Galileo Galilei		
William Herschel		
Giovanni Schiaparelli		
Johannes Kepler		
Asaph Hall		
Percival Lowell		



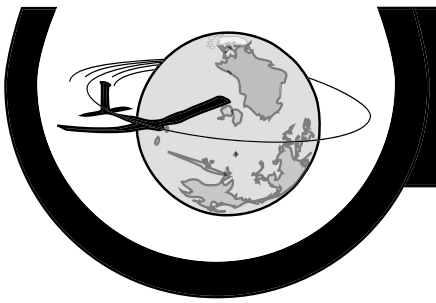
Research Projects

Person / Program	Year	Information Gathered
Viking Missions		
Mariner Missions		



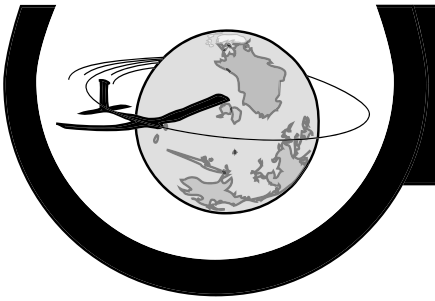
Research Projects

Person / Program	Year	Information Gathered
Mars Global Surveyor		
Phobos 1 & 2		
Mars Observer		
Mars Pathfinder		
Mars Sojourner		



Research Projects

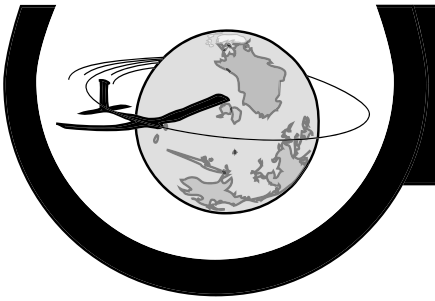
Person / Program	Year	Information Gathered
Mars Surveyor '98 Orbiter		
Mars Surveyor '98 Lander		



Research Projects

Teacher's Reference Key

Person / Program	Year	Information Gathered
Chinese	**3,000 BC**	*Observed its orbit.*
Aristotle	**300 BC**	*Observed that Mars was farther from Earth than the moon was.*
Galileo Galilei	**1609**	*Recorded phases of Mars.*
Johannes Kepler	**1609**	*Determined Mars' orbit to be elliptical.*
William Herschel	**1771**	*Saw bright changing patches that he thought were clouds suggesting an atmosphere this convinced him that Mars was similar enough to Earth to support life.*
Giovanni Schiaparelli	**1877**	*Observed dark lines on Mars' surface and called them "canali" (channels).*
Asaph Hall	**1877**	*Discovered Martian satellites: Phobos & Deimos.*
Percival Lowell	**1894**	*His observations determined that dark lines connected dark patches which fueled the idea of canals being built by intelligent life.*



Person/Program Information Gathering

Mariner Missions:

Mariner 4

Year: 1965
Type: fly-by spacecraft
Mission objectives:

1. close-up scientific observations of Mars & transmit to Earth;
2. perform field & particle measurements in interplanetary space in the vicinity of Mars;
3. give experience in & knowledge of the engineering capabilities for interplanetary flights of long duration.

Results:

1. returned 21 pictures to Earth as it got within 9,846 km of the Martian surface;
2. met all objectives.

Mariner 6

Year: 1969
Type: fly-by spacecraft
Mission objectives:

1. gather & send data & test new features.

Results:

1. Spacecraft instruments took TV images of Mars;
2. measured the radio refractivity;
3. measured the UV & IR emissions of the Martian atmosphere;
4. passed within 3,431 km of Martian surface.

Mariner 7

Year: 1969
Type: fly-by spacecraft
Mission objectives:

1. gather & send data & test new features.

Results:

1. mission was successful.

Person/Program Information Gathering

Mariner 8 (failed to launch properly)
Year: 1971

Mariner 9
Year: 1971
Type: orbiter & lander
Mission objectives:
1. map surface of Mars;
2. study temporal changes in the Martian atmosphere & on the Martian surface.

Results:
1. Gathered data on atmospheric composition, density, pressure & temperature;
2. Gathered data on surface composition, temperature and topography of Mars.

Viking Missions:

Viking 1 & 2
Year: 1976
Type: orbiter & lander
Mission Objectives:
1. obtain high resolution images of Martian surface;
2. characterize the structure and composition of the atmosphere & surface;
3. deploy seismometer;
4. search for evidence of life.

Results:
1. geography of planet: volcanoes, lava plains, immense canyons, cratered areas, wind-formed features, evidence of surface water; Northern low plains; Southern cratered highlands;
2. soil = iron-rich clay;
3. temperature range: 150 - 250 K;
4. Climate = seasonal dust storms, pressure changes, transport of atmospheric gases between polar ice caps observed;
5. life = no evidence.

Person/Program Information Gathering

Phobos 1 & 2

Year: 1988
Type: orbiter
Mission objectives:

1. conduct studies of the interplanetary environment;
2. perform observations of the Sun;
3. characterize the plasma environment in the Martian vicinity;
4. conduct surface & atmospheric studies of Mars;
5. study surface composition of the Martian satellite Phobos.

Results:

Phobos 1	error in software deactivated thrusters which resulted in the solar arrays facing away from the Sun, thus depleting the batteries— contact lost.
Phobos 2	malfunction of on-board computer meant loss contact.

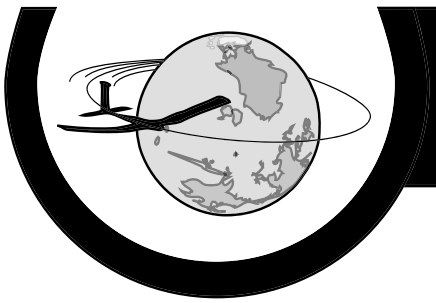
Mars Observer

Year: 1993
Type: orbiter/lander
Mission objectives:

1. determine the global elemental and mineralogical character of the surface material;
2. define globally the topography and gravitational field;
3. establish the nature of the Martian magnetic field;
4. determine the temporal and spatial distribution, abundance, sources and sinks of volatiles and dust over a seasonal cycle; and
5. explore the structure and circulation of the atmosphere.

Results:

Three days before it was to establish orbit around Mars, contact was lost (reasons unknown).



Research Projects

Person/Program Information Gathering

Mars Global Surveyor

Year: 1997
Type: spacecraft/ Mars satellite
Mission objectives:

1. take high resolution images of the surface (mapping);
2. perform studies of the Martian topography and gravity;
3. determine the role of water and dust on the planet's surface and in the atmosphere;
4. perform studies of the weather and climate of Mars;
5. determine the composition of the surface and atmosphere;
6. determine the existence and evolution of the Martian magnetic field;
7. serve as a transmitter for future missions.

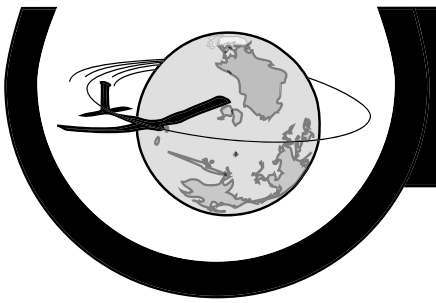
Results:
Mission in progress.

Mars Pathfinder

Year: 1997
Type: stationary lander with surface rover
Mission objectives:

1. demonstrate the feasibility of low-cost landings on and exploration of the Martian surface (Through tests of communications between the rover and lander, the lander and earth, as well as tests of the imaging devices and sensors.);
2. other studies to include the following:
   - atmospheric entry science;
   - long-range and close-up surface imaging to characterize the Martian environment for further exploration.

Results:
Mission in progress.



Research Projects

Person/Program Information Gathering

Mars Sojourner

Year: 1997
Type: Remote controlled surface rover (six wheeled vehicle)
Mission objectives:

1. demonstrate the feasibility of low-cost landings on and exploration of the Martian surface.

Results:

Mission in accomplished.

Mars Surveyor '98 Orbiter

Year: 1998
Type: Spacecraft / Mars Lander
Mission objectives:

1. monitor the daily weather and atmospheric conditions;
2. record changes on the Martian surface due to wind and other atmospheric effects;
3. determine temperature profiles of the atmosphere;
4. monitor the water vapor and dust content of the atmosphere;
5. serve as data relay satellite for the Mars '98 Lander and other future missions.

Results:

Mission is ongoing with data being received.

Mars Surveyor '98 Lander

Year: 1998
Type: Spacecraft / Lander
Mission objectives:

1. record local meteorological conditions near the Martian south pole;
2. analyze samples of the polar deposits for volatiles, particularly water an carbon dioxide;
3. dig trenches and image the interior;
4. image the regional and immediate landing site surroundings.

Results:

Mission failed due to Lander impacting Mars' surface at high speed.